

The U.S. Navy in the Post-Cold War World

The U.S. Navy has changed its doctrine and reduced its size since the mid-1980s, when the United States and the Soviet Union were engaged in the Cold War. Day to day, however, the Navy continues to perform many of the same tasks that it did 15 years ago. The service's budget has shrunk by about 35 percent since 1985 (adjusting for inflation); consequently, fewer ships are deployed overseas. But the number of operations the Navy has been called on to carry out has risen. If that trend continues, the Navy will find it increasingly difficult to modernize the fleet, maintain the same level of operational readiness and overseas presence as in the past, and provide a good quality of life for its sailors, pilots, and marines.

In this study, the Congressional Budget Office (CBO) focuses on four questions that are central to the Navy's future:

- o What missions might the Navy be asked to perform between now and 2020?
- o Does the Navy have a viable plan to sustain and modernize its current fleet of about 300 ships?
- o Can the Navy pay for that plan if its funding is limited to an inflation-adjusted level of \$90 billion per year (roughly the average amount budgeted under the Future Years Defense Program for fiscal years 2001 through 2005)?

- o What are some possible alternatives to the Navy's current force structure and modernization plan?

Conceptually, determining what missions the Navy should perform or whether it has enough ships to do so ought to begin by understanding the U.S. role in the post-Cold War world and how specific foreign policy objectives would support that role. From that understanding would follow a national security strategy, which would include the option of military force and how it might be used to execute that strategy. Then, planners could determine the missions that the Navy (or any of the services) should be ready to perform, the Navy's size and composition, and the level of funding necessary to support its force structure.¹ Although vital, questions about the role of U.S. interests and foreign policy objectives in shaping the nation's military strategy or the Navy's missions, structure, and budget are beyond the scope of this analysis. So are questions of whether or to what extent the current Navy is consistent with the national security strategy.

1. Very different foreign policies and national security strategies could lead to very different naval missions, force structures, and budget levels. For example, U.S. foreign policy today calls for an active presence in world affairs; consequently, the Navy deploys a large percentage of its fleet overseas in support of that policy. A foreign policy that articulated a much less active role for the United States might well lead to many fewer ships being deployed overseas, a smaller fleet, and a smaller budget for the Navy.

Instead, this study analyzes the size, composition, and funding requirements of the Navy with only general reference to the current national security strategy. The core objectives of that strategy, as articulated by President Clinton, are to enhance U.S. security, bolster the nation's economic prosperity, and promote democracy abroad.² To achieve those goals, the United States pursues a variety of lesser objectives. They include maintaining a military presence in many regions around the globe, promoting an open trading system, exporting U.S. goods and services, protecting the flow of oil from exporters to importers, and maintaining the military capability to win two major theater wars nearly simultaneously as well as to conduct smaller operations.

Sea power—through the missions that the Navy and its related service, the Marine Corps, perform—is a fundamental element in achieving both the broad and the specific goals of the national security strategy. This chapter reviews changes in the strategy and missions of the Navy since the Cold War, the Navy's current force structure, recent attempts to determine the optimum size of that force, the service's plans for procuring and modernizing ships, and potential threats to U.S. naval forces around the world.

The Evolution of Naval Strategy and Missions Since the Cold War

During the Cold War, the U.S. Navy's main mission was to counter the threat posed by Soviet maritime forces. If a war had broken out in Europe, Soviet submarines and long-range bombers would have tried to disrupt supplies and reinforcements being shipped from the United States to Europe. Soviet (and now Russian) naval forces in the European theater have always been geographically constrained. Thus, before they could attack U.S. resupply convoys crossing the North Atlantic, Soviet submarines and bombers would have had to traverse two relatively narrow waterways:

one between Greenland and Iceland and the other between Iceland and the United Kingdom (an area commonly called the GIUK gap at that time).

As a result, the North Atlantic Treaty Organization (NATO) advocated a strategy of "sea control," which called for setting up defensive barriers between Greenland, Iceland, and the United Kingdom. NATO antisubmarine forces—including U.S. subs—would try to intercept Soviet submarines before they reached the Atlantic Ocean. Similarly, U.S. aircraft based on carriers and in Greenland, Iceland, and the United Kingdom would attempt to shoot down Soviet bombers before those bombers could use their long-range cruise missiles against NATO shipping.

As the Soviet and U.S. navies grew during the Cold War, the U.S. Navy developed an offensive strategy in the mid-1980s called the maritime strategy. It called for attacking Soviet maritime forces as far forward as possible—in their home bases or as they traversed the Norwegian Sea en route to the Atlantic. Navies are much easier to find and more vulnerable when they are in port or in more confined waters. The maritime strategy argued that if Soviet forces were found and attacked under those conditions, they would be much less likely to reach the open ocean and disrupt NATO sea control. As part of that strategy, U.S. attack submarines would try to destroy not only Soviet subs capable of firing nuclear ballistic missiles but also the attack submarines guarding them in defensive bastions near the Soviet homeland.³

In either the sea control or the maritime strategy, defense planners presumed that the Soviet Union would attack U.S. vessels in the open ocean with submarines and land-based bombers. Consequently, during the Cold War, the U.S. Navy made investing in attack submarines and antisubmarine warfare systems its highest priority. A close second was equipping its surface ships with sophisticated systems to defend against attack from the air. In the later portion of the maritime strategy—once Soviet maritime forces had been eliminated—deep-strike aircraft from carriers would be used to attack the Soviet Union itself. On the basis of those strategies, the U.S. Navy's goal dur-

2. The White House, *A National Security Strategy for a New Century* (December 1999), p. iii.

3. Admiral William A. Owens, *High Seas: The Naval Passage to an Uncharted World* (Annapolis, Md.: Naval Institute Press, 1995), pp. 3-4.

ing most of the 1980s was to have a fleet of 600 ships, including 100 attack submarines and 15 aircraft carriers.

With the end of the Cold War and the dramatic decay of the Russian navy, the United States was left without a major rival for control of the seas. As a result, the U.S. Navy began to question its mission. It moved away from the maritime strategy when it published the white papers . . . *From the Sea* in 1992 and *Forward . . . From the Sea* in 1994. Instead of warfare in the open ocean, those documents emphasized projecting military power ashore. With the United States capable of controlling the world's oceans and no major threat to maritime transportation in view, the Navy began to concentrate almost exclusively on fighting smaller, regional foes in the world's littoral (coastal) areas. As its principal peacetime mission, the Navy emphasized overseas, or forward, presence—having its ships patrol the world's oceans to deter trouble.

Among the Navy's many missions, sea control and forward presence are paramount: sea control makes performing the Navy's other tasks possible, and forward presence makes performing them easier. At any given time, about half of U.S. naval forces are at sea—either deployed forward in key regions around the world, going to and from those regions, or training for deployment. With those forces, the Navy keeps in place the military power necessary to control the sea lanes. Military and commercial shipping can traverse those waters but only with the acquiescence of the U.S. Navy.

By controlling the sea lanes, the Navy can carry out such peacetime tasks as evacuating noncombatant U.S. personnel from crisis situations, providing humanitarian assistance and disaster relief, enforcing sanctions, combating narcotics smuggling, supporting peacekeeping operations, reinforcing U.S. diplomacy, and reassuring allies.⁴ In wartime, the Navy's major

missions would include projecting U.S. power ashore with Tomahawk cruise missiles, carrier aircraft, or Marine amphibious forces.

Among their other missions, U.S. naval forces—especially attack submarines—also gather intelligence, which is one of the few missions that does not necessarily depend on control of the sea. In addition, naval forces conduct a variety of missions aimed at deterring potential aggressors from attacking their neighbors or threatening U.S. interests. Ballistic missile submarines, which are virtually invulnerable to detection and attack, are the mainstay of the U.S. strategic nuclear force. They provide an extra measure of deterrence beyond the quick military response that forward-deployed naval forces represent. (The Navy may have another mission in the future: using surface combat ships to provide a defense against ballistic missiles.)

The Current Organization of the Navy

The Navy organizes many of its ships into battle groups centered around 12 aircraft carriers. During the Cold War, a notional carrier battle group consisted of one carrier surrounded and protected by six surface combatants. Those ships usually consisted of two cruisers or destroyers (equipped with the Aegis combat system for air defense) and four destroyers or frigates (to defend against opposing submarines and surface vessels). Rounding out the group were combat logistics ships for resupplying the carrier and the surface combatants. In addition, attack submarines were sometimes assigned to provide support to a battle group, but they were not well integrated with the group's operations.

Today, the composition of a notional carrier battle group varies according to the severity of the likely threat and the mission to be undertaken. Nevertheless, those groups still look much like they did during the Cold War. One difference is that attack submarines operate more often with battle groups now to help guard against enemy subs. With less need to perform independent missions against Russian nuclear subma-

4. Generally, the Navy and the Marine Corps are used more often than the Air Force or the Army to respond to international events or crises. See Barry M. Blechman and Stephen S. Kaplan, *Force Without War: U.S. Armed Forces as a Political Instrument* (Washington, D.C.: Brookings Institution, 1978), pp. 38-48. See also Department of the Navy, *Vision . . . Presence . . . Power: A Program Guide to the U.S. Navy* (1999).

Table 1.
Distribution of Navy Ships, 1990 and 2000

	1990		2000	
	Number of Ships	Percentage of Fleet	Number of Ships	Percentage of Fleet
Aircraft Carriers	15	3	12	4
Surface Combatants	213	37	116	37
Attack Submarines	97	17	56	18
Ballistic Missile Submarines	35	6	18	6
Amphibious Ships	66	11	39	12
Combat Logistics Ships	60	10	34	11
Mine Warfare Ships and Fleet Auxiliaries	88	15	41	13
Total	574	100	316	100

SOURCE: Congressional Budget Office based on data from the Navy.

rines than during the Cold War, U.S. submarines are becoming more integrated with battle-group operations.

At the beginning of 2000, the Navy possessed 116 surface combatants (see Table 1). Although the majority are associated with carrier battle groups, the remainder are available for independent presence missions, crisis response, exercises, and specialized missions. Surface combatants, including those equipped with Tomahawk missiles and the Aegis air-defense system, sometimes form what used to be called surface action groups. Those groups substitute for carrier battle groups where gaps exist in maintaining forward presence, responding to crises, or conducting other independent missions.⁵ For example, the Navy regularly sends the Middle East Force, a surface action group, to the Persian Gulf. (Surface ships of the U.S. Coast Guard sometimes also take part in overseas presence missions. Their role is discussed in Box 1.)

Like surface combatants, attack submarines can also be used for independent missions. Those missions include collecting intelligence off the coast of a hostile nation or landing teams of special-operations forces ashore. (In practice, roughly two-thirds of the

Navy's submarine missions gather intelligence whether they are supporting a carrier battle group or not.) During the Cold War, in contrast, most U.S. submarines were devoted to tracking and, in the event of war, attacking Russian ballistic missile and attack submarines.⁶ The U.S. Navy would probably consider that to be the primary mission of its attack submarines once again if relations between the United States and Russia deteriorated significantly.

The Navy's amphibious ships are organized into 12 amphibious ready groups (ARGs) of about three ships each. Those groups sometimes accompany carrier battle groups to conduct forward presence missions or respond to crises, but they can also operate independently. ARGs are designed for such missions as landing Marines in a limited amphibious assault, rescuing noncombatant personnel during a crisis, and providing humanitarian assistance.

An amphibious ready group is usually centered around a large flat-deck ship that is similar to a medium-sized aircraft carrier (but smaller than the very large carriers that are the mainstay of the U.S. Navy). The flat-deck ship helps transport marines and

5. See Robert Holzer, "114 Navy Warships Won't Do the Job, Study Says," *Navy Times* (June 6, 1994), p. 34.

6. For a picture of submarines' new missions, see Don Ward, "New Horizons: As Subs Surface from the Cold War, the View Is Friendlier but Busier," *Navy Times* (November 15, 1993), p. 14.

equipment to shore. It can also launch helicopters and fixed-wing aircraft that take off and land vertically, landing craft that travel on a cushion of air, and amphibious personnel carriers that “swim” to shore. The other, smaller amphibious ships in an ARG can also launch helicopters, landing craft, and amphibious vehicles. In the long term, as newer, more-capable amphibious ships replace more-numerous older models, each ready group will comprise one large flat-deck ship, one amphibious transport dock, and one dock landing ship.

A fast combat logistics ship (also known as a station ship) accompanies every aircraft carrier battle group to supply fuel, ammunition, and dry-cargo provisions. The combat logistics force also contains shuttle ships for each of those commodities; shuttle ships

travel from port to the battle group to resupply the station ship. Other support ships that do not operate with carrier battle groups or amphibious ready groups include surveillance ships for hunting submarines, tenders that provide a floating maintenance facility for other vessels, ships used to clear mines, and open-ocean tugboats.

Rounding out the Navy are 18 ballistic missile submarines, the portion of U.S. nuclear forces that are considered most likely to survive a nuclear war. Those submarines are very quiet and operate independent of other forces. In a nuclear war, they would launch their missiles while hiding in the deep ocean. The Navy intends to reduce that force to 14 submarines by 2004.

Box 1.

The Role of the U.S. Coast Guard

The Coast Guard is the fifth armed service of the United States. It is much smaller than the other services, with about 35,000 uniformed and 6,000 civilian personnel and an annual budget of about \$4 billion. Unlike the other services, it is part of the Department of Transportation. The Coast Guard's fleet consists of 125 cutters and large patrol boats, 190 aircraft and helicopters, and many small boats. That fleet both supplements and complements the Navy, but it also has unique responsibilities and missions.

The Coast Guard's high- and medium-endurance cutters, though smaller than Navy frigates, participate in overseas combat operations and peacetime presence missions. During the Vietnam War, Coast Guard cutters patrolled Vietnamese waters, providing gunfire support to troops and attacking enemy supply routes, base camps, and rest areas. More recently, a Coast Guard cutter was assigned to the Navy's Sixth Fleet and is helping to patrol the Adriatic Sea after the NATO air campaign against Serbia. Coast Guard cutters are regularly involved in presence missions to ports on the Mediterranean Sea and the Persian Gulf.

The Coast Guard's primary mission is the coastal defense of the United States, and its performance of that mission frees the Navy to operate else-

where. The Coast Guard is responsible for protecting millions of square miles of ocean and thousands of miles of coastline from relatively low intensity threats such as narcotics trafficking and illegal immigration. The Navy is also responsible for protecting U.S. shores from those types of threats, of course, but its principal focus in coastal defense is on the greater perils posed by the navies of potentially hostile nations.

Unlike the Navy, the Coast Guard is also a law-enforcement organization. In effect, Coast Guard personnel are the police, firemen, and paramedics of the sea. They enforce marine regulations, respond to environmental hazards such as oil spills, and conduct search-and-rescue operations for boats and aircraft lost at sea.

The Coast Guard hopes to embark on a \$15 billion acquisition program known as Deepwater to replace many of its aging ships and aircraft. The program is also intended to integrate the Coast Guard's sensors, ships, and aircraft to make the service a smaller but more effective force. Currently, the Coast Guard is soliciting design plans from three teams of contractors. The Congress is expected to authorize the first ship in that program after fiscal year 2001.

Determining How Big the Navy Should Be

Determining the size of the Navy depends heavily on a myriad of assumptions. They include what the Navy's ships will be used for, how many commitments or conflicts are expected, how capable the ships are, what level of force is necessary to do the job, and how hard the ships' crews are worked.

Strategy Reviews in the 1990s

Since the end of the Persian Gulf War in 1991, the Department of Defense (DoD) has carried out two major strategy reviews to determine the proper size and composition of U.S. military forces, including the Navy. The first was conducted in 1993 as part of the department's Bottom-Up Review (BUR). The second, held in 1997, was called the Quadrennial Defense Review (QDR). Different assumptions led the two reviews to different conclusions about what the future Navy should look like. Despite those assumptions, however, the reductions in U.S. naval forces that occurred during the 1990s appear to have been driven largely by declining budgets, brought on by the collapse of the Soviet Union.

The plan that emerged from the BUR decreased the Navy's force goal from 574 ships in 1990 to 346 ships by 1999.⁷ The recommended number of carriers was reduced to 12 and attack submarines to between 45 and 55. But the BUR was unclear about the required number of surface combatants, which may explain how it could recommend a specific number for the total fleet but a range for the attack submarine force. Later, the overall force goal was lowered to 331 ships—to save funds to modernize the fleet—but it was restored to 346 in 1995 by the Chief of Naval Operations. That decision was apparently made because of a more optimistic outlook for the Navy's budget and because naval forces were being heavily used

for overseas forward presence and crisis-response missions.⁸

The 1997 Quadrennial Defense Review revisited the Navy's force goal and further reduced the recommended numbers of attack submarines and surface combatants.⁹ Subsequent Navy statements and briefings and DoD's 1998 *Annual Report* to the President and the Congress confirm a force goal of slightly more than 300 ships by 2003. That goal includes 12 aircraft carriers, 116 surface combatants, 50 attack submarines, and 41 amphibious ships (see Table 2). In addition, the 2000 *Annual Report* and the President's budget for fiscal year 2001 added five submarines and possibly one surface combatant to that goal.

The BUR and the QDR illustrate the difficulty in determining the optimum size and composition of the Navy. Despite the substantial differences between the two reviews, each maintained that the naval forces it recommended were sufficient to fight two major theater wars nearly simultaneously as well as to maintain a robust forward presence. In fact, the Bottom-Up Review specifically stated that 10 carrier battle groups were adequate to fight two such wars but that 12 were necessary to maintain a forward presence in three key regions of the globe: the Western Pacific, the Persian Gulf and Arabian Sea, and Europe (usually the Mediterranean Sea).

Current Reviews of Naval Forces

In preparation for the next Quadrennial Defense Review, set to begin in 2001, the Navy continues to study its structure in detail. One review, the Surface Combatant Force Level Study II, is examining whether the Navy needs more than 116 surface combatants to perform all of the missions required of that fleet.¹⁰ Preliminary analysis argues that by 2015, with the likely addition of theater missile defense to its missions, the

7. Secretary of Defense Les Aspin, *Report on the Bottom-Up Review* (October 1993), p. 28.

8. John Burlage and Ernest Blazar, "Drawdown Doesn't Jibe with Navy's Course," *Navy Times* (July 3, 1995), p. 4.

9. Secretary of Defense William S. Cohen, *Report of the Quadrennial Defense Review* (May 1997), pp. 29-30.

10. Robert Holzer, "Requirements Rise May Force Larger U.S. Warship Fleet," *Defense News* (May 24, 1999), p. 1.

Table 2.
Drawdown of Navy Ships Between 1990 and 2003

	1990	1994 (BUR) ^a	2000	2003 (QDR Goal)
Aircraft Carriers	15	12	12	12
Surface Combatants	213	110	116	116
Attack Submarines	97	87	56	50
Ballistic Missile Submarines	35	16	18	14
Amphibious Ships	66	41	39	41 ^b
Combat Logistics Ships	60	47	34	34 ^c
Mine Warfare Ships	8	15	16	16
Fleet Auxiliaries	<u>80</u>	<u>59</u>	<u>25</u>	<u>23</u>
Total	574	387	316	306 ^d

SOURCE: Congressional Budget Office based on data from the Navy.

NOTE: BUR = Bottom-Up Review; QDR = Quadrennial Defense Review.

- a. These numbers represent the Navy's force level shortly after the BUR was published, not the BUR force goal, which was 346 ships.
- b. As the Navy replaces more-numerous older ships with more-capable ships, this number will fall to 36 by 2007.
- c. As the Navy replaces more-numerous older ships with more-capable ships, this number will fall to 31 by 2012.
- d. Under the QDR, this number was supposed to fall to 298 by 2012. However, in 2000 the Department of Defense added five submarines and, apparently, one surface combatant to its force goal. Thus, by 2012 the total would be 304.

Navy would need as many as 95 surface combatants for peacetime operations. The service has not yet determined how many of those ships it would need to carry out combat missions, but the number would be larger, perhaps around 140. It is not clear when, if ever, the Navy will issue that report.¹¹ Moreover, if a national missile defense system is deployed on surface ships, the requirements for those vessels will increase substantially.

The guidance from recent DoD reviews is also ambiguous when it comes to determining the size of the attack submarine force. The Bottom-Up Review specified that 45 to 55 boats would be necessary to meet combat requirements but that the lower number of that range would jeopardize the Navy's ability to perform peacetime missions. Somewhat arbitrarily, the QDR rounded that number to an even 50. In

March 1998, military officials argued before the Senate Armed Services Committee that requirements for attack submarine deployments, "which include CVBG [carrier battle group] deployments, national tasking, arctic operations, special forces missions, and independent presence missions[,] would dictate a force of 72 attack submarines."¹² A 1999 study for the Chairman of the Joint Chiefs of Staff determined that the Navy needs 55 submarines by 2015 to meet wartime requirements and between 55 and 68 to fulfill the most critical peacetime requirements.

In the absence of a real enemy to fight, the size of the attack submarine force might be driven by the number of submarines that U.S. political and military leaders want to keep forward deployed. According to a Navy calculation, 5.8 submarines are necessary to keep one submarine forward deployed at all times.

11. The first version of that analysis was done in the early 1990s and argued that the Navy needed 120 to 135 surface combatants to fulfill peacetime presence missions and 135 to 165 ships to fulfill wartime requirements.

12. Ronald O'Rourke, *Navy Attack Submarine Programs: Background and Issues for Congress*, Report for Congress RL30045 (Congressional Research Service, February 4, 1999), p. 21.

Thus, using the Navy's formula, 50 submarines can keep eight submarines operating in that manner.

Although the size of the Navy's fleet has fallen since 1993, the carrier force has remained steady at 12. That number appears to be a compromise between what is required for forward presence and what the Navy needs to fight wars. As noted above, the Bottom-Up Review stated that 10 carriers were enough to fight two regional wars nearly simultaneously but that keeping an aircraft carrier deployed in East Asia, the Persian Gulf area, and the Mediterranean at all times would require a force of 15 carriers.¹³

According to the BUR, 12 aircraft carriers can provide a high level of presence in those regions and meet warfighting needs "at an acceptable level of risk."¹⁴ What that appears to mean is that 12 carriers can meet the requirements for both warfighting and forward presence with about two-month gaps each year in their coverage of the Mediterranean and Persian Gulf areas. In the event that full-time forward presence was necessary because of a crisis, the carriers could be kept at their stations longer than their usual six-month deployment, albeit at the risk of exhausting their crews. Restoring the Navy to a force of 15 aircraft carriers would be an expensive proposition: procurement costs would reach more than \$30 billion if all new ships and aircraft were built, and operating and support costs would add about \$1 billion annually. Conversely, cutting the carrier fleet to 10 would save money but leave extremely large gaps in presence in the Mediterranean and the Persian Gulf—in the absence of any remedial actions that could keep the carriers on patrol longer.¹⁵

The requirements for the carrier fleet depend on a host of assumptions, such as what type of future carriers the Navy buys, how frequently and how long they are deployed, the time required for crews to achieve a

high level of readiness, and the availability of overseas home ports for carrier battle groups. Analyses by outside organizations have come to similar or different conclusions than DoD depending on the assumptions they used. For example, a study by the Center for Naval Analyses showed that an 18-month deployment cycle for carriers could generate the same amount of forward presence as a 21-month cycle but with two fewer carriers.¹⁶

Procuring and Modernizing Navy Ships

Although the overall size of the Navy is in flux, the service is developing or building a new ship for each major type of vessel it uses. Because the service lives of ships range from 30 to 50 years, all of the ships that the Navy is buying today or that it plans to buy in the next 10 years will probably still be in the fleet in 2020, and some will still be there in 2040. Thus, they represent major claims on the Navy's future resources.

Procurement Since the Cold War

While its strategy and missions shifted in the 1990s, the Navy continued to buy either the same weapons it had purchased during the Cold War or new versions of them (with the exception of attack submarines). For example, the Navy is still buying the DDG-51 Aegis-equipped destroyer, which was designed to counter massive attacks by Soviet cruise missiles over open water. The DDG-51 (the Arleigh Burke class) is not as effective in the more cluttered littoral environment. Moreover, early versions of the ship cannot house a helicopter, which is a potent weapon against coastal patrol boats armed with antiship missiles—the main naval weapon of many potential regional adversaries.

For two other types of vessels—aircraft carriers and submarines—the Navy is not straying far from the ships it now deploys. Although it has begun research

13. See Aspin, *Report on the Bottom-Up Review*; and Congressional Budget Office, *Improving the Efficiency of Forward Presence by Aircraft Carriers*, CBO Paper (August 1996).

14. Department of the Navy, *Vision . . . Presence . . . Power*, p. 13.

15. Creating a home port in the Mediterranean or bringing in a new crew while an aircraft carrier was in its theater of operations rather than back in the United States could keep carriers at their stations for a much longer time. See Congressional Budget Office, *Improving the Efficiency of Forward Presence by Aircraft Carriers*.

16. William H. Sims, *Budget-Driven Carrier Employment Options and Implications for Future Carrier Design* (Alexandria, Va.: Center for Naval Analyses, July 1992), pp. 6-7.

and development of an aircraft carrier to replace the current Nimitz class ships, it still has one Nimitz under construction and will order another in 2001. The Navy also purchased a third Seawolf submarine in 1996 and began buying its less expensive successor, the Virginia class attack submarine, in 1998. The Virginia is the first major naval weapon that is designed to perform missions in littoral areas but is still able to operate effectively in the blue water of the open ocean.

In the area of aircraft procurement, the Navy has begun buying the E/F model of the F-18 fighter. That aircraft can fly farther and carry a bigger payload than its predecessor—the F-18C/D—which should make it more useful as a bomber and thus better for operations against land targets in coastal regions.¹⁷ In the longer term, one version of the Joint Strike Fighter is expected to become the Navy's principal aircraft for ground attacks.

Although the total number of U.S. ships will drop to 316 in 2000 from 574 a decade earlier, the distribution of forces among the service's three major warfare "communities"—air, surface, and undersea—remains similar to what it was during the Cold War (see Table 1). The force has become slightly more "carrier heavy"—that is, the number of aircraft carriers has been reduced by less than the number of surface combatants and submarines (by 20 percent versus 46 percent and 44 percent, respectively). Nevertheless, the balance of forces among the three communities has not changed greatly, and all of them continue to modernize by buying new, more-capable weapons. Thus, although Navy officials might disagree, the current force could be characterized as a reduced version of the Cold War Navy.

The fact that changes in force structure and procurement lag behind changes in strategy and missions is not surprising. Historically, that is almost always true for any nation or military. When the Cold War ended, many years and dollars had been invested in researching, developing, and procuring weapons (such as the Arleigh Burke destroyer and the Nimitz carrier)

designed for combat against the Soviet navy. Because the service lives of ships are so long, the entire force structure could not be transformed quickly—except at very great expense.

Modernizing Aircraft Carriers

Most of the 12 aircraft carriers that the Navy operates are Nimitz class vessels. That class was originally designed in the 1960s, but each new ship built since then has been modified and improved. Now, the Navy would like to change the design of its carriers and develop a new class.

Building and operating an aircraft carrier over its 45- to 50-year service life is expensive. A carrier begun today would cost \$5 billion to \$6 billion to procure and outfit and \$15 billion to operate and support over 50 years, CBO estimates. Much of that cost is for paying the crew of around 3,500 people who operate the carrier (and the other 2,000 or so personnel who operate and support the carrier's air wing). The Chief of Naval Operations hopes to reduce the personnel needed for an aircraft carrier by nearly 30 percent by using new technology that would automate many tasks now performed by crew members.¹⁸ Redesigning the carrier's nuclear propulsion plant so that it would not need to be refueled during its lifetime could also save money. The Navy considers a new, more-efficient power plant its first priority in the modernization program.

Originally, the Navy intended to redesign the carrier all at once—developing a new class of ship—with the first new vessel to be authorized in 2006. But that revolutionary design fell victim to budgetary realities. Navy officials recognized that the service lacked the \$6 billion to \$7 billion necessary to develop the new ship. Consequently, they adopted a more evolutionary approach. The Navy will increase the amount of money it spends on new technologies that can be incorporated into the CVN-77, the Nimitz class carrier that it wants to order in 2001. More new technology will be incorporated into succeeding ships, the CVN-

17. According to the General Accounting Office, however, the E/F model does not provide significant improvements over the C/D in its performance as a fighter plane. See General Accounting Office, *Navy Aviation: F/A-18E/F Will Provide Marginal Operational Improvement at High Cost*, GAO/NSIAD 96-98 (June 1996).

18. Joe Hart and Rick Lazisky, *CVX: An Evolutionary Path to a Revolution in Naval Warfare*, Critical Issues Paper (Arlington, Va.: Center for Security Strategies and Operations, August 28, 1998), p. 15.

Table 3.
Capabilities of Navy Attack Submarines

	Los Angeles Class (Improved)	Seawolf Class	Virginia Class
Size			
Displacement (Tons, submerged)	6,900	9,100	7,800
Length (Feet)	360	353	377
Draft (Feet)	32	35	31
Beam (Feet)	33	40	34
Speed (Knots)			
Maximum	33	35	34
Tactical (Silent speed)	n.a.	20	n.a.
Operating Depth (Feet)	950	about 1,600	more than 800
Crew Size	129	133	113
Armament (Number of missiles or torpedoes)	37	50	38
Weapon Launchers			
Torpedo tubes (21 inches) ^a	4	8	4
Vertical launch system cells	12	0	12

SOURCE: Congressional Budget Office.

NOTE: n.a. = not available.

a. The Seawolf has 26.5-inch torpedo tubes that launch its weapons.

78 and CVN-79, which will be the first ships of the evolved CVNX class. The Navy has not yet determined—and probably does not yet know—which new technologies will fit within the existing Nimitz hull and which will not.¹⁹

The Navy may have to live with the decisions it ultimately makes about the new carrier for a long time. If the CVN-77 is authorized in 2001 and commissioned in 2006, it will probably remain in service until after 2050 (assuming the same service life as today's carriers). The first carrier of the new CVNX class will be authorized in 2006 and probably commissioned in 2013. If the Navy buys 10 of those ships—as it expects to do with the Nimitzes—the last CVNX

would still be in service after 2100. If the evolutionary approach to carrier design does not work, the Navy can, of course, stop the new class after producing a few ships and begin again. But such a decision would be very costly.

Modernizing Attack Submarines

The mainstay of the U.S. attack submarine force at the end of the Cold War and today is the Los Angeles class submarine. Sixty-two were built; about 55 remain in the force. Over the next 20 years, most of those submarines will reach the end of their useful service life. To replace them, the Navy first developed the Seawolf. Although it was arguably the most capable submarine in the world, the Seawolf was also the most expensive. That program was canceled, and only three of the submarines were ordered.

19. Robert Holzer, "Navy Sinks Futuristic Carrier: Service Abandons CVX, But Will Test Technologies on Next Nimitz," *Defense News* (May 25, 1998).

The Virginia class attack submarine was proposed in 1990 by the Chief of Naval Operations as a lower-cost successor to the Seawolf. The Navy expects it to be as quiet as the Seawolf but somewhat less capable in terms of the weapons it carries (see Table 3). However, the Virginia is designed to be flexible enough to conduct missions in support of the Navy's doctrine of littoral warfare—something the Seawolf and Los Angeles classes are less capable of doing—and to serve as a hedge against the possibility of a rejuvenated Russian submarine threat. The Virginia class submarines will be able to carry out various missions, including stealthy strikes with Tomahawk missiles, antisubmarine warfare in the littorals and deep water, antiship warfare, covert intelligence, and mine laying against enemy shipping. Those submarines will also be able to support carrier battle groups and special-operations forces. The Navy's current modernization program calls for buying 30 Virginia class submarines at a total cost of around \$60 billion.

Modernizing Surface Combatants

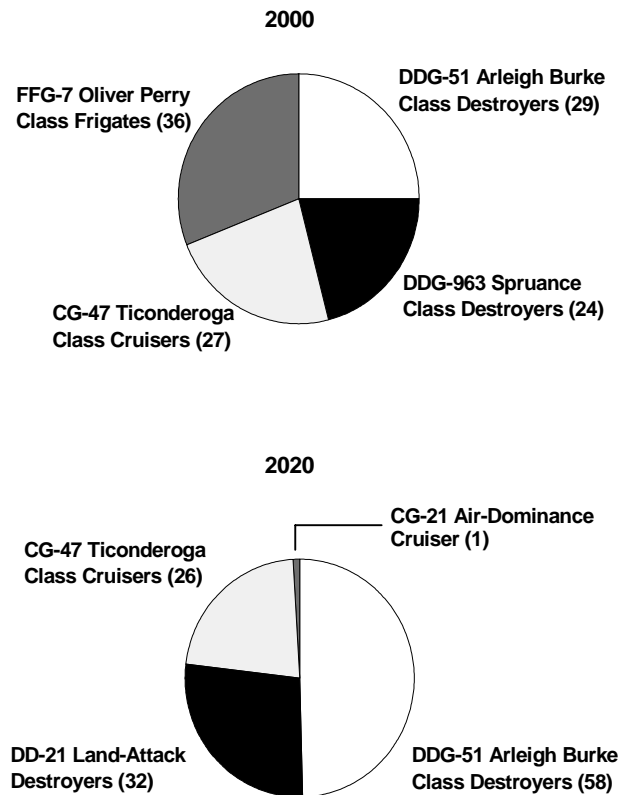
The Navy's current surface combatant force is composed of four types of ship: Ticonderoga class cruisers, Arleigh Burke class destroyers, Spruance class destroyers, and Oliver Perry class frigates. By 2020, the Navy will probably still have four types of surface combatants, but they will be different types. The DD-21 Zumwalt class land-attack destroyer will replace the Spruance destroyers and the Perry frigates, and the fleet may have one new CG-21 air-dominance cruiser (see Figure 1).

Currently, the Navy has only one building program for surface combatants, that for the Arleigh Burke destroyers. Authorization for that program will end in 2005 at 58 ships (with the last commissionings in 2010). Also in 2005, the Navy expects to order the first DD-21—the first ship specifically designed for the post-Cold War environment and littoral warfare.²⁰ It is expected to have a highly stealthy design to reduce its chance of being detected during the close-to-

shore operations it is intended to conduct. The DD-21 is also designed to be highly effective at antisubmarine warfare and to have a greater land-attack capability than any other ship in the fleet, except aircraft carriers. Its land-attack weapons will include 128 to 256 vertical launch system cells containing missiles with varying ranges; it will probably also carry two advanced gun systems for high-volume fire support.

As with the CVNX carrier, the Navy is hoping to keep procurement and life-cycle costs for the DD-21 low through the use of new technology. The service would like to spend no more than \$750 million (in fiscal year 1996 dollars) per ship. It also hopes to keep the size of the crew to around 100—compared with the 340 or more personnel required for other cruisers and destroyers now in the fleet. The Navy's plan is to

Figure 1.
The Navy's Surface Combatant Force, 2000 and 2020 (By number of ships)



SOURCE: Congressional Budget Office.

20. If the DD-21 program is delayed further, as appears likely, the Navy may need to buy more Arleigh Burke destroyers to maintain the industrial base for building destroyers. According to news reports, the Navy has already discussed that possibility.

use automated systems, sensors, and the like to reduce the number of people needed for damage control, shipboard logistics, and other areas of the ship's operations.

Is the cost goal for the DD-21 realistic? One way to answer that question is to consider historical norms. Research has shown that new ship designs typically cost 15 percent more than their predecessors. Arleigh Burke destroyers, which some observers might view as the predecessor of the DD-21, cost around \$900 million to \$1 billion to procure today. Thus, a \$750 million DD-21 would cost about 25 percent less than an Arleigh Burke destroyer. Arleigh Burkes, however, are equipped with the Aegis combat system, a highly effective but also extremely expensive air-defense capability, which the DD-21 will not have. If one considers Spruance class destroyers to be the DD-21's true predecessor, then the target of \$750 million may fit within historical norms. But the changes and new technologies that the Navy hopes to introduce in the DD-21 make it likely that the ship will have a price tag closer to that of the Arleigh Burke.

Reducing the size of the crew may be more difficult than keeping costs down, in part because the Navy's goal is so ambitious. By cutting the number of crew members for a destroyer by more than two-thirds, the Navy hopes that the DD-21 will have annual operating and support costs equal to no more than 30 percent of those for the Arleigh Burke. But questions remain about whether such a drastic reduction in personnel will decrease the effectiveness of the DD-21 or, worse, its survivability in combat.²¹

Foreign Threats Facing the U.S. Navy

What ability do other powers have to threaten, undermine, or otherwise inhibit U.S. naval forces from executing their missions? In many respects, very little. Most analysts would agree that the United States is by

far the strongest naval power in the world. In fact, its current level of superiority is probably comparable only with those of the U.S. Navy immediately after World War II and the British navy after the Battle of Trafalgar during the Napoleonic Wars—times when their opponents' fleets had been destroyed and no new opposition had yet arisen.

Comparing the United States' current naval forces with those of its potential adversaries—whether by simply counting ships or by comparing the quality of the ships, leadership, personnel, and organization—leads to the conclusion that no other nation can directly defeat the U.S. Navy anywhere in the world, either today or for the foreseeable future. However, one threat that may loom on the horizon is the possibility that a hostile power could deny U.S. naval forces access to an area by using large numbers of relatively cheap weapons, such as mines and antiship cruise missiles.

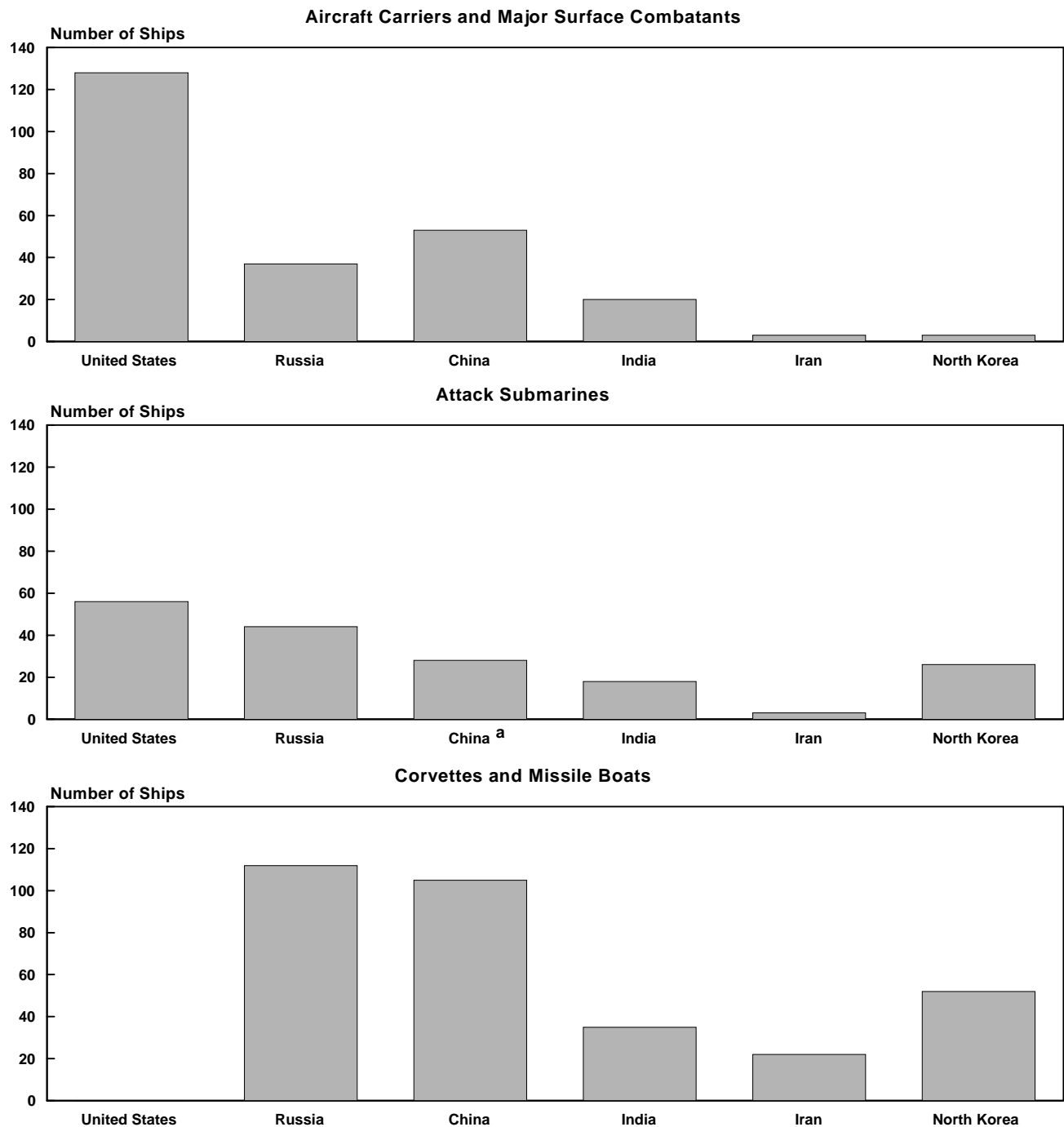
The Russian and Chinese Navies

U.S. relations with both Russia and China have been uneasy since the end of the Cold War. Although the United States and those countries share some interests, they disagree about various foreign policy issues. For example, U.S. relations with Russia deteriorated after NATO launched an air campaign against Serbia, a traditional friend of Russia, in March 1999. At one point, Russian President Boris Yeltsin claimed that he had not ruled out military intervention in the conflict. Relations with China took a turn for the worse in 1996, when China fired several ballistic missiles at Taiwan in an apparent effort to intimidate its leadership. The United States responded by sailing parts of the Seventh Fleet—including the aircraft carrier *Independence*—through the Taiwan Strait. Since then, U.S. military planners have monitored developments in both China and Russia closely. They consider both nations to be potential threats.

After the United States, Russia and China have the largest navies in the world. Their forces each have large numbers of surface warships and submarines (see Figure 2). Technologically, however, the fleets of both nations are much less capable than the U.S. Navy.

21. See, for example, Captain Pierre Vining, "Can a Minimum-Manned Ship Survive Combat?" *Proceedings*, U.S. Naval Institute (April 1999), pp. 80-83.

Figure 2.
Naval Force Levels of the United States and Selected Countries, 1999



SOURCE: Congressional Budget Office based on data from Captain Richard Sharpe, ed., *Jane's Fighting Ships, 1999-2000*, 102nd ed. (Alexandria, Va.: Jane's Information Group, 1999); and International Institute for Strategic Studies, *The Military Balance, 1999-2000* (London: Oxford University Press, 1999).

NOTE: The Russian fleet is in a serious state of decline. It has little money for training, deployments, or weapons, and major units of the fleet spend only a few days a year at sea.

a. Excludes China's obsolete Romeo class submarines.

Russia. Although the Soviet navy was once easily the second most powerful fleet in the world, the Russian navy, like Russia itself, has fallen on hard times. The number of ships has dropped dramatically, from nearly 300 large warships in the Soviet fleet in 1985 to less than 100 in the Russian fleet today. Moreover, the Russian navy is in a serious state of decline because of a lack of funding. With little money for training, deployments, or weapons, major parts of the fleet spend only a few days a year at sea. When major repairs or refits on a ship come due, more often than not the ship is abandoned.²²

Although much of that situation applies to the submarine fleet as well, Russia has made a greater effort to maintain production of new submarines than it has with other types of ships. For example, the Russian navy now appears to be producing one Akula II class submarine a year, but how long that pace can continue is unclear. Russia is also reported to be developing a new attack submarine, the Severodvinsk, and a new ballistic missile submarine, the Borey. But progress on both appears to be limited. Construction of the Severodvinsk either is extremely slow or has been suspended altogether—with an uncertain future. Only one Borey is under construction, and work appears to have been suspended because of problems at the shipyard and with the manufacturer.²³ Some analysts have speculated that the new Akulas are quieter than the Los Angeles class, the mainstay of the U.S. attack submarine force. But such concerns may be exaggerated. Those Russian submarines may indeed be quieter at very slow speeds—5 to 7 knots—but they are much noisier than Los Angeles class submarines at the higher speeds associated with normal combat operations.²⁴

China. The Chinese navy has grown rapidly over the past several decades, and it could one day challenge U.S. naval forces. As yet, however, it does not pose a threat comparable with that of the Soviet navy during the Cold War. In the late 1970s, the Chinese had fewer than two dozen major surface warships. By 1998, that number had grown to more than 50 ships that were much more capable. China's submarine force has not increased much in quantity, but its quality has improved considerably as new Chinese-built submarines, as well as submarines bought from Russia, replace old Soviet models.²⁵ China appears to have a long-term goal to build and deploy a genuine blue-water navy. Nevertheless, the nation has no aircraft carriers and only about half as many major surface combatants as the United States.²⁶ And not one of those surface combatants appears to be as capable as a U.S. Spruance class destroyer—much less an Aegis-equipped cruiser or destroyer.²⁷

China's amphibious fleet is also composed of dozens of ships, but those ships together can carry fewer than 8,000 troops and 250 tanks. China has recently revived production of its Yuting class amphibious ship and built four of them over the past year. They can carry 250 troops, 10 main battle

U.S. Navy Overestimates Stealth, Might of Russian Subs," *Defense News* (July 29, 1996), p. 50.

22. See the Haze Gray and Underway Naval History Information Center, *World Navies Today: Russia* (2000), available at www.hazegray.org/worldnav/russia/. See also Captain Richard Sharpe, ed., *Jane's Fighting Ships, 1999-2000*, 102nd ed. (Alexandria, Va.: Jane's Information Group, 1999), p. 556.

23. Sharpe, *Jane's Fighting Ships, 1999-2000*, pp. 558, 560. See also the Haze Gray and Underway Naval History Information Center, *World Navies Today: Russia*.

24. Reported to the Congressional Budget Office in a briefing by the Navy, September 18, 1996. See also Rear Admiral Michael Cramer as cited in Ivan Eland, *Subtract Unneeded Nuclear Attack Submarines from the Fleet*, Foreign Policy Briefing No. 47 (Washington, D.C.: Cato Institute, April 2, 1998), p. 5; and Robert Holzer, "Study:

25. For a good discussion of these issues and Russian submarine programs, see O'Rourke, *Navy Attack Submarine Programs*, pp. 14-19.

26. Periodically, there are rumors that China is building or trying to buy an aircraft carrier. But China does not appear to be close to doing so, and it would take years before it had the means to project power with an aircraft carrier. Acquiring such a vessel is only one obstacle. Training crew members and supporting a carrier are not skills that can be learned quickly.

27. Both the Spruance and China's largest and most modern warship, the Sovremenny class destroyer bought from Russia (China has no cruisers), displace about 8,000 tons and have comparable speeds and cruising ranges. The Chinese ship carries eight antiship cruise missiles; the Spruance has eight Harpoon antiship cruise missiles. The Sovremenny class destroyer has two surface-to-air missile launchers with 44 missiles (but no area air-defense radar), compared with 61 vertical launch system cells on the U.S. ship capable of firing Tomahawk missiles and antisubmarine rockets. The Chinese ship has four 130-millimeter guns and four torpedo tubes; the Spruance has two 5-inch guns and six torpedo tubes. China has purchased two of those ships and may buy two more. See Sharpe, *Jane's Fighting Ships, 1999-2000*, pp. 119, 810.

Box 2.**Are Surface Ships Becoming More Vulnerable?**

A growing number of naval analysts contend that surface ships—especially aircraft carriers—are becoming increasingly vulnerable to attack.¹ That vulnerability began in World War II, they argue, but it could reach a critical stage soon as potentially hostile regional powers acquire large stocks of cheap antiship missiles and diesel-electric submarines.

The Six-Day War in the Middle East in 1967, the Falklands War in 1982, and the Iran-Iraq War in the late 1980s provide evidence of how vulnerable surface ships are to small, inexpensive missiles and submarines. In 1967, the defense world was surprised when a small Arab patrol boat sank the larger Israeli destroyer *Eilat* with antiship missiles. During the Falklands War, Argentine aircraft equipped with sea-skimming Exocet missiles sank five British surface ships and damaged 11 more.² On the other side of that conflict, the British nuclear submarine *Conqueror* sank the Argentine heavy cruiser *General Belgrano* in a torpedo attack. (That submarine also kept the entire Argentine navy bottled up in port for the rest of the war.)³ And during the Iran-Iraq War, an Iraqi aircraft mistakenly attacked and severely damaged a U.S. naval vessel—the frigate *U.S.S. Stark*—with an Exocet antiship missile. (That frigate and other U.S. ships were escorting Kuwaiti oil tankers to protect them from attack by Iran.)

Some analysts who argue that surface ships are increasingly vulnerable also maintain that aircraft carriers will become the most vulnerable surface ships of all. Although the Navy hopes to reduce the radar silhouette of

carriers in future versions of the ship, their huge size and angular shape make such a reduction difficult. Aircraft carriers are also vulnerable to saturation attacks by large numbers of antiship missiles. At first glance, the decline of Soviet maritime forces appears to reduce the likelihood of such attacks. But because carriers are more likely to operate in coastal areas now than during the Cold War, some analysts believe that the proliferation of inexpensive but deadly antiship missiles among potential regional adversaries will make coastal operations more dangerous.

Nations armed with antiship missiles are unlikely to possess the same large quantities as the former Soviet Union, but they could still pose a substantial threat because carrier battle groups operating closer to shore would have to react more quickly with less information. Battle groups that faced antiship missiles mounted on fast patrol boats nearby or on shore-based launchers might not have as much time to react to incoming missiles as they would have had in a confrontation with Soviet missiles launched from bombers hundreds of miles away. In addition, “land clutter”—trees, buildings, and other objects that radar cannot see through—could allow hidden, shore-based enemy launchers to surprise a battle group. During the Gulf War, such clutter rendered the sophisticated Aegis air-defense system on U.S. cruisers and destroyers much less effective than it would otherwise have been.⁴

New technologies, however, could ultimately permit effective countermeasures to those threats. For example, microwave or high-energy lasers might enable a surface ship to defeat saturation attacks by antiship cruise missiles. High-powered microwaves aimed at a salvo of incoming missiles might be able to disrupt their avionics simultaneously, rendering the attack ineffective. Other new technologies that are being explored to protect ships include water-barrier technology, which shoots up a large wall of water in front of a ship just before incoming missiles are about to strike. The missiles explode harmlessly against the water or are knocked out of the air. That technology has been tested successfully against single incoming missiles, and defense planners hope it will eventually be able to defeat groups of missiles.

1. See, for example, James F. Dunnigan, *How to Make War: A Comprehensive Guide to Modern Warfare for the Post-Cold War Era* (New York: William Morrow, 1993); George Friedman and Meredith Friedman, *The Future of War: Power, Technology and American World Dominance in the Twenty-First Century* (New York: St. Martin's Griffin, 1996), pp. 180-204; and John Keegan, *The Price of Admiralty: The Evolution of Naval Warfare* (New York: Viking, 1989), pp. 266-275.
2. Max Hastings and Simon Jenkins, *The Battle for the Falklands* (New York: Norton, 1983), pp. 351-360.
3. James L. George, *The U.S. Navy in the 1990s: Alternatives for Action* (Annapolis, Md.: Naval Institute Press, 1992), p. 73.

4. Friedman and Friedman, *The Future of War*, pp. 198-199.

tanks, four landing craft, and two helicopters.²⁸ (In contrast, the U.S. Navy has fewer amphibious ships but can carry about five times the number of troops as the Chinese ships. And some of the U.S. amphibious ships could be used to strike other sea- or land-based targets.)

Other Nations' Navies

Other powers with which the United States might one day come in conflict have much smaller naval forces than Russia and China do. Iraq has never possessed much of a navy and has none now. Iran's navy comprises a few frigates, two dozen corvettes or missile boats, and several diesel-electric submarines purchased from Russia. Those submarines appear to worry U.S. naval planners the most (as discussed in the section below). In addition, just this year, Iran built and launched its first domestically produced submarine. India has built a large fleet that seemingly represents equally large ambitions, but financial constraints have apparently dampened its ardor in recent years.²⁹

Area-Denial Strategies

The Navy is less occupied with analyzing the threats that specific countries pose and more with what defense planners call capabilities-based threat analysis. In other words, analysts try to determine what capabilities (technologies and weapon systems) are available on the international arms markets that could ultimately threaten U.S. Navy ships.

The capabilities that the Navy worries about most involve relatively cheap weapon systems that countries can buy abroad or produce at home in quantity—mines, antiship cruise missiles, fast-attack torpedo and missile boats, and small diesel-electric submarines.³⁰ If a country had enough of those weap-

ons, it could implement what defense analysts refer to as an asymmetric area-denial strategy. Such a strategy would not attempt to challenge and defeat U.S. naval forces directly. Instead, it would seek to inhibit the U.S. Navy's operations in a region by strewing coastal areas with mines, putting hundreds of antiship cruise missiles along the shore, and having several quiet diesel-electric submarines roam littoral waters.³¹ Many analysts worry that surface ships are becoming increasingly vulnerable to such measures. (For more details, see Box 2 on page 15.) As the Navy puts it, "In future crises and conflicts . . . access-denial weapons could make the projection of U.S. power so costly that the United States might be deterred from acting."³²

In one possible scenario for an area-denial strategy, Iran might be able to prevent the U.S. Navy from operating in the Persian Gulf by mining the Strait of Hormuz and then guarding it with antiship cruise missiles and small submarines to thwart mine-clearing operations.³³ Could China do the same with the Taiwan Strait?

The purpose of such area-denial strategies is to prevent the United States from defending its interests or its allies. The Korean War offers a historical example. The amphibious assault by U.S. forces at Wonsan was delayed for eight days by mines, prompting the U.S. commander to declare, "The U.S. Navy has lost control of the seas."³⁴ And North Korea did not even have a fleet.

pendent propulsion—that do not need to come to the surface frequently to charge their batteries or refresh their air supplies, the threat could be especially potent.

28. Robert Sae-liu, "China Revives Yuting-class Ship Programme," *Jane's Defence Weekly* (June 14, 2000), p. 87.

29. Admiral J.G. Nadkarni, "Indian Navy Stands at a Crossroads," *Proceedings*, U.S. Naval Institute (March 1998), pp. 70-72.

30. See Department of the Navy, Office of Naval Intelligence, *Challenges to Naval Expeditionary Warfare* (1997), pp. 7-13. If those submarines are of the new "closed system" variety—also known as air-inde-

31. Simon Saradzhyan, "Russia Expects to Boost Exports of Ships and Subs," *Defense News* (June 1, 1998), p. 10. See also Joris Janssen Lok, "Mini Submarines and Special Forces Pose Maximum Threat," *Jane's International Defense Review* (June 1998), pp. 63-68; and Captain Ed Smith, "They Can Buy It, But . . ." *Proceedings*, U.S. Naval Institute (February 1994), pp. 45-48.

32. Department of the Navy, *Vision . . . Presence . . . Power*, p. 3.

33. See Department of the Navy, Office of Naval Intelligence, *Worldwide Submarine Challenges* (1997), pp. 29-31. See also Andrew F. Krepinevich, Jr., *A New Navy for a New Era* (Washington, D.C.: Center for Strategic and Budgetary Assessments, May 1996).

34. James L. George, *The U.S. Navy in the 1990s: Alternatives for Action* (Annapolis, Md.: Naval Institute Press, 1992), pp. 175-176.